

6; length of wings 26·5, breadth 13·25; length of abdomen 15; length of fore coxa 11·75, femur 12·5.

Hab. Perak, Malay Peninsula. Collected by Mr. W. Doherty.

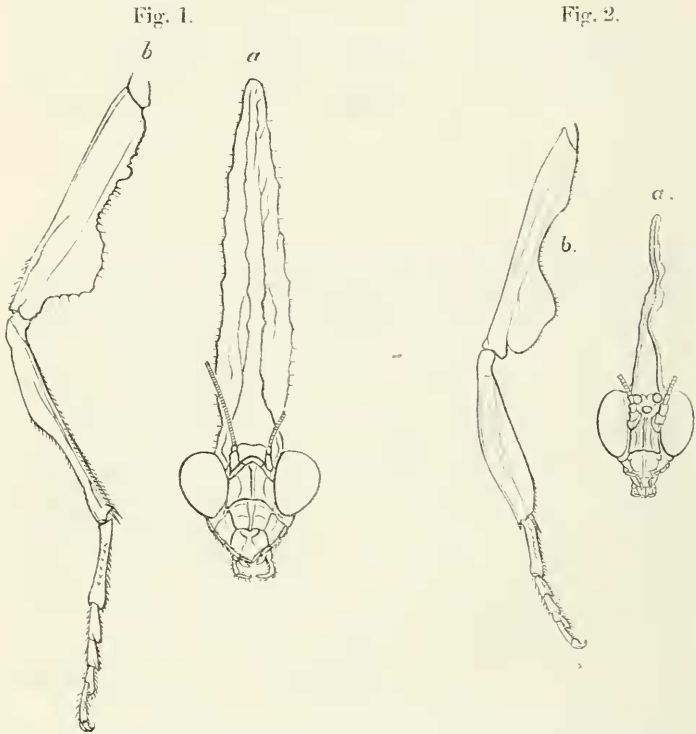


Fig. 1.—*P. taprobanae*. *a*, head, from in front; *b*, intermediate leg of left side, from above, $\times 4$.

Fig. 2.—*P. malaya*. *a*, head, from in front; *b*, intermediate leg of left side, from above, $\times 4$.

LI.—*Notes on the Early Life-history of the Herring.* By
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PROFESSOR M'INTOSH having kindly placed at my disposal a series of young herrings obtained in St. Andrews Bay during the last five years, I have been able to ascertain some facts as to the life-history of the herring which may be of interest.

I do not propose to enter here into any minute structural details.

As is well known, all herrings do not spawn at the same time, some selecting the spring and others the autumn for that purpose. Professor McIntosh is of opinion that by far the greater number spawn in the spring; and this seems confirmed, so far as regards this locality, by the greater abundance of young forms obtained here in that season.

Mr. Brook ('Fourth Annual Report Scotch Fishery Board') gives January to March as the spring spawning-season, the time varying with the locality, Anstruther and Buckie being the earliest.

The egg of the herring is demersal, differing thus from the pelagic egg of the sprat. The intraovarian development of the herring has been worked out by Kupffer and subsequently by Brook (3rd and 4th Ann. Rep. S. F. B.).

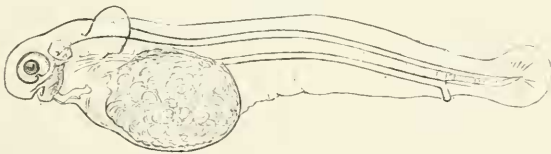
Eggs were obtained here on Feb. 5, 1885, from Anstruther, and hatched out in the laboratory in twenty-five days.

Newly hatched forms occurred on March 7, 1887, and larval and post-larval forms in March and the beginning of April in 1887 and 1889.

The period of incubation varies with the temperature*. It is probably never less than three weeks in the early spring, but it may be barely a week in the autumn. Thus, except in very early localities, young herrings cannot be expected before the beginning of March. In 1889 great numbers of young herrings were obtained, the first being early postlarval forms on March 22 and larval and postlarval on March 28.

The newly hatched herring (figure 1), about $\frac{7}{16}$ inch long†,

Fig. 1.



is in the larval condition ‡, *i. e.* the yolk is still unabsorbed. The absorption of the yolk takes three or four days, when the

* See Mr. Brook's account of Meyer's experiments with regard to temperature, 3rd Annual Report Fishery Board for Scotland, 1884, p. 49.

† Kupffer gives the length of the newly hatched Baltic herring at 5.2-5.3 millim. (3rd Ann. Rep. S. F. B. 1884, p. 47).

‡ Mr. J. T. Cunningham gives a figure of a larval herring in Trans. R. S. E. vol. xxxiii. pt. 1. It differs slightly from my own figure.

postlarval condition is reached. The mouth is from the first widely open and the eyes a brilliant silvery blue, the newly hatched herring being thus in advance of its ally the sprat.

For the first few days of its life the herring is unable to rise from the bottom, lying on its side and occasionally lashing out with its tail; and even when able to rise it seems to keep near the bottom for some time, larval and early postlarval forms being taken together in great abundance in the bottom trawl-net used at this laboratory on the 30th March, 1889. The postlarval herring is very voracious, not disdaining cannibalism, whilst it is preyed on doubtless by larger fishes. The growth of the herring is at first slow, there being an increase of about $\frac{1}{24}$ inch in the first ten days of free life.

Becoming more vigorous, the postlarval herrings ascend into midwater; specimens (fig. 2) $\frac{5}{12}$ inch long were taken

Fig. 2.



with the midwater-net on March 22, 1889, being thus somewhat earlier than their fellows.

At this length the permanent dorsal fin is clearly indicated, the cartilages of the hyoid and branchial arches are well developed, the pectoral fins are pediculate, the tail shows an indication of the heterocercal condition. The continuous embryonic (median) fin is still retained; the maxillæ are well developed, and bear sharp-pointed teeth on their anterior edges.

On April 14, 1889, the herrings were still in midwater, a little over half an inch in length; the embryonic median fin was nearly or quite lost, and the hypural elements of the tail were well marked.

Pigmentation* other than that of the eyes appears before the postlarval condition is reached and is retained unchanged for a considerable period. It is entirely black, and consists of one or two median chromatophores below the heart, a chain of about ten chromatophores commencing behind each pectoral fin and running backwards on each side of the gut for about half its length; an irregular, sometimes double, chain ventral to the posterior half of the gut; two (sometimes one) stellate

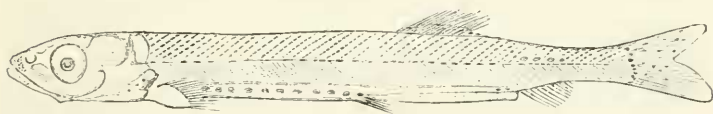
* Cf. Prof. McIntosh and E. E. Prince, "Development and Life-histories of Food-fish," Trans. R. S. E. vol. xxxv.

chromatophores on each side a little in front of and above the vent. Stellate chromatophores are also developed above the posterior end of the notochord, and more abundantly below it. Still in midwater the young herrings appeared next on May 16, 1887, and May 22, 1889, about $\frac{3}{4}$ inch long; the embryonic fin was now entirely lost. Then they were lost sight of till July 20^{*}, when the length was $1\frac{1}{8}$ inch. They have now something of the appearance of the adult. The gill-cover is developed; the caudal and dorsal fins are in the adult condition, and pelvic and anal fins have appeared. The dorsal fin is immediately anterior to the anus. The body is transparent and scales are absent. The early pigmentation is faint and additional black pigment is appearing at the bases of the dorsal fin-rays, along the back behind the dorsal fin, on the caudal fin, sparingly on the gill-cover, and in the pia mater of the cerebellum.

The herring now seems to desert the deep water for the neighbourhood of the shore, being taken in August in the seine-net on the sands in company with sprats and sand-eels (*Ammodytes tobianus*). It also probably roves about the bay in the same company, forming the "herring sile" known to fishermen and offering great attractions to guillemots and sea-gulls. It is now $1\frac{1}{4}$ inch long; the dorsal pigment extends forward to the head, the lateral line is pigmented, and the pigment of the head and tail is more profuse.

In September the young herring is still on the sands (fig. 3), $1\frac{1}{2}$ to $1\frac{3}{4}$ inch long; the body is still transparent and scale-

Fig. 3.



less, the silvery pigment of the peritoneum is visible. The early pigmentation is almost lost; pigment-dots mark the divisions of the myomeres dorsal to the lateral line. The sides of the body and operculum gleam with a silvery green; the dorsal surface of the head is blotched with yellow, the upper and lower jaws are black, and the pigmentation of the pia mater forms two well-marked pyriform patches over the cerebellum.

In January the young herring is found again in midwater

* Prof. McIntosh and Mr. Prince mention a herring $1\frac{1}{8}$ inch taken on the 1st July (*op. cit.*).

$1\frac{3}{4}$ inch long; scales are now developed, but seem confined to the anterior and ventral parts of the body. The vertebrae are well ossified.

Ewart and Matthews (3rd Ann. Rep. S. F. B.) found a few herrings, $1\frac{1}{2}$ inch long, amongst the shoals of sprats forming the Forth Whitebait in January. From January we must pass to September, when the herring is found on the sands, about $2\frac{1}{2}$ inches long, in the usual company. It has now all the characters of the adult, external and internal, but is probably sexually immature.

One specimen of the herring $4\frac{1}{2}$ inches long was obtained in company with the last, and is probably a year older.

The career of the young herring has now been traced from the spring of one year to the autumn of the next, and perhaps a year longer, with fair continuity, and its rate of growth noted. (Dr. Meyer was enabled to trace the growth of the herring of the Baltic both in confinement and under natural conditions for five months. He gives 65–70 millim. as the size of a five-months' herring (3rd Ann. Rep. S. F. B. p. 50).) Of its subsequent proceedings the specimens here afford no evidence. It probably goes into deeper water. The record of autumn-hatched herrings is less satisfactory. Eggs came under my notice in the middle and end of August; but, as pointed out by Prof. McIntosh and Mr. E. E. Prince (*op. cit.*), there must be considerable variability in the autumn spawning-period, some forms being hatched perhaps in July, whilst others, as appears below, are but a few days old on the 20th September. Incubation is shorter, as the temperature is higher, than in the spring. Eggs were hatched in this laboratory during this September in from seven and a half to eight and a half days. On Sept. 20 we found in midwater postlarval forms varying from $\frac{7}{25}$ to $\frac{4}{25}$ inch, that is, from a few days to a month old. In November 1888 we found them $\frac{2}{3}$ inch long, and in March 1889, on the bottom, $1\frac{1}{2}$ inch long. Beyond this I have not been able to trace them.

LIH.—*Description of a new Species of Water-Shrew from Unalaska Island.* By G. E. DOBSON, M.A., F.R.S.

THE type of the very interesting species of Water-Shrew about to be described* was found by me in the excellent

* This species would have been described, as I had hoped, long ago in the third part of my 'Monograph of the Insectivora;' but the state of my health having prevented the appearance of that part, I am anxious to obviate further delay by immediate publication of the following description.